

The State of the Art of EHF-Puncture Devices

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International Journal of Acupuncture and Oriental Medicine, 1996, VII, (1-4): 43-44

Abstract. EHF-puncture is a new method of treatment, based on biological effects of low intensive electromagnetic radiation of MM band. This new puncture modality requires special medical generators of MM waves. Authors review different devices which can be applied to carry out various versions of EHF-therapy.

Extremely High Frequency (EHF) Therapy is a new method of treatment which is based on different biological effects of low intensive electromagnetic radiation (EMR) of millimeter (MM) band. Present experience strongly suggests EHF-Therapy can be divided into three independent branches^[1]: Microwave Resonance Therapy (MRT),^[2,3] Extremely High Frequency (EHF) Puncture^[4] and simple Extremely High Frequency (EHF) Therapy.^[5]

The formation of these three versions of EHF-Therapy was conditioned by several types of the effects appearing during EHF-influence: specific effects associated with the frequency of MM EMR, nonspecific effects associated with the irradiated zone and non-specific effects conditioned by developing the General adaptation syndrome (GAS).

- Microwave Resonance Therapy (MRT) requires individualization of the therapeutic frequency for every patient or for every disease.
- During EHF-Puncture one needs individualization of irradiated zone-acupoint in accordance with Acupuncture theory of traditional Chinese medicine (TCM).
- The last version of EHF-Therapy does not individualize frequency of EMR as well as irradiated zone.

Every version of EHF-Therapy requires special MM EMR generator:

1) For MRT a broad stripe generator - with changeable MM EMR frequency - is necessary. It also must be able to initiate sensory reactions on the certain frequency, which is accepted as a «resonance» frequency (G4-141, G4-142, Ariya, AMRT, Artsakh, etc.).

2) For EHF-puncture generators with coherent or «noise» radiation and with dielectric waveguide usually are applied. Sensory reactions must appear during influence upon any selected acupoint (G4-141, G4-142, Ariya, AMRT, Electronica-EHF, Artsakh, etc.).

3) EHF-Therapy without individualization frequency of MM EMR as well as irradiated zone requires generators with horn antenna and fixed frequency (Yav-1, Yarmarka, Shlem, Artsakh, Porog, etc.).

«Yav-1» devices are produced in two versions: Yav-1, 7.1 mm and Yav-1, 5.6 mm.^[6] The source of emission represents an avalanche-diod (AD) oscillator. Horn antenna (2.0 cm² in cross-section) has output power density not less than 10 mw/cm².

«Yav-1» device operates in the continuous oscillation mode and frequency modulations used at frequency 50 Hz. Frequency deviation band is over + 80 Mhz.

«Electronica-EHF» is produced having operation frequency $f = 61.0 \pm 2.1$ GHz, output power 5 mW, and may operate both in continuous and pulse oscillation modes.^[7] The source of MM emission is AD. It differs from Yav-1 by existence of decoupling devices (ferrite waveguide), isolators and bandpass filters.

«Ariya» device has been developed in 1990.^[8] The specific feature of this device is that it includes a waveguide-stripline oscillator manufactured on basis of Indium/Phosphide Gunn diode. Operation frequency band of the device is $f_0 = f_c \pm 4$ GHz, where central frequency (f_c) may vary within the range from 54.0 to 77.5 GHz. The output power is not less than 1 mW. Three operation modes of emitted signal are possible: continuous mode, frequency modulation mode with frequency deviation band ± 50 MHz, and amplitude-modulation mode with frequency modulation in the range from 1 to 100 Hz. Power supply is from a.c. mains, 220 V, and does not exceed 10 W.

Further progress in EHF-Therapy is related with the progress into new frequency bands and functional characteristics of emission devices.

On the base of theoretical and experimental researches we have devised and manufactured a new series of devices «Artsakh».

«Artsakh»: Avalanche diode is used as an active element for generator in all frequency bands, which provides high operating characteristics of «Artsakh».^[9] Broadband frequency tuning has become possible due to application of similar AD in the pre-break-down mode.

Application of MRT devices in clinical practice has shown that the most «delicate» problem is determination of resonance therapeutic frequencies, usually based on patients' subjective sensor reactions. However there are patients (elderly people, children or persons weakened by chronic disease) whose sensor reactions may be expressed weakly, which may result in errors of therapeutic frequency determination.

In order to overcome this drawback of known devices we have proposed a MRT method in which a solid-state noise generator of MMW is used. Noise emission spectrum of «Artsakh-02M» and «Artsakh-03M» devices covers the frequency bands from 42.0 to 95.0 and 90.0 to 140.0 GHz, respectively.^[10]

Since every biological object represents a frequency selective system, it chooses its eigen frequency from the entire noise spectrum. Thus no determination of therapeutic frequency is necessary in this case and we may escape errors.

«Artsakh» device consists of a generator unit, power supply, control and indication unit. Generator unit is mounted on pantograph by means of which the emission may be led to a selected acupoint or zone on the patient's body. Modes of operation are: continuous generation, internal meander amplitude-modulation and external modulation. Automatic switch off for generator is used when the exposition time is over.

«Artsakh-01M» has two regimes of emission: coherent frequency with $f_0 \pm 4$ GHz, where frequency f_0 may lie at any point in the range from 25 to 120 GHz, and «noise» with $f_0 \pm 10$ GHz.

«Artsakh-02M» also has two regimes of generation: «noise» with frequencies from 42 to 95 GHz and combination of coherent emission (frequency 60.0 ± 1 GHz) and «noise».

«Artsakh-03M» has two regimes of generation: «noise» in range of 90.0 - 140.0 GHz and combination «noise» and coherent irradiation ($f = 118 \pm 1$ GHz).

Thus all multiservice and multifunctional characteristics of «Artsakh» devices give one possibility to provide them for any versions of EHF-Therapy effectively.

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